



Agricultural Policy Issues



One in a series of notes on agricultural policy issues of interest to Canada
This note draws on analysis from a number of institutions, listed on page 5.

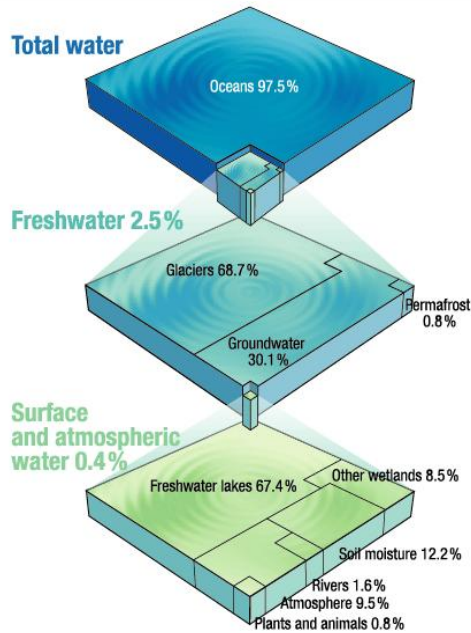
Agriculture in a Water-Scarce World Managing the world's most important liquid asset

1. Introduction and Overview

More than one-third of the world's population lives in water-stressed countries although, globally, water appears to be abundant (Figure 1). Fresh water resources are not always available at both the right place and time, nor are they always well managed. As climate change alters the nature and severity of weather events, the incidence and amplitude of water-related stresses will rise. Thus, the importance of managing water resources well will also rise.

Important agricultural regions in China, India, Mexico, Australia, Africa, the U.S., and elsewhere are now near the brink of serious water shortages. Global water requirements are expected to increase by 40 percent over the next 20 years. If trends continue, by 2025 competition between urban, industrial, and agricultural water uses will curb both economic growth and agri-food production, causing yearly global shortfalls of 350 million tonnes of food. Seventy percent of the world's freshwater is used for irrigation. Conventional irrigation is less than 50 percent efficient. Thus, the greatest potential gains exist in the agri-food sector.

Figure 1. Distribution of Global Water Resources



Sources: Shiklomanov, I (1999), UNESCO, UNEP, World Meteorological Organisation, FAO, International Council of Scientific Unions, World Glacier Monitoring Service, United States Geological Survey, as summarized by Environment Canada.

2. Water Resources and Policy Choices: Competing Demands, Complex Tradeoffs

The value of water resources to society is often underestimated, resulting in over use, depletion or degradation of the resource. There is often a gap between market value and the economic value of water when the full cost of environmental goods and services is included.

Water policy failures arise when inadequate consideration of impacts on others occur, particularly with regard to the environment. Bias toward sectors that exercise strong economic and political power can further marginalise the concerns of other sectors. Subsidized irrigation, electricity and land conversion may be manifestations of this. Subsidizing irrigation water results in a price that is less than its true worth to society. Farmers respond to low prices by using amounts of water that exceed the social optimum. In an extreme case, this can result in over abstraction of aquifers in some localities and water-logging elsewhere.

Another policy challenge is the provision of subsidies to drain land and to divert surface water, both of which can contribute to the degradation or destruction of wetland sites and watercourses.

Competition for water is intensifying and agriculture is often cited as the principal 'user' of raw water. Yet, with few exceptions, most countries have treated water as an almost free resource.

3. Water Resource Policy: International Insights

UN and CGIAR agencies have extensively studied water allocation and management systems. A few guiding principles have emerged, as discussed below.

- **Comprehensive Assessments** are advocated. Reforms and valuation efforts have been most successful when done at a basin level. Such approaches bring environmental and socioeconomic consequences to bear in private and public decisions, and better value water across competing uses and over time.
- **Cut Red Tape, Promote Inclusion.** Efficiency and effectiveness could be improved in most countries by providing a better mix of market-based, voluntary and regulatory instruments. Efficient, effective and self enforcing means of prioritizing and allocating water to be developed and embraced. Buy-in is critical – whether through inclusive consultation or via incentives and market mechanisms.
- **Transparency and accountability** are sometimes lacking. As water becomes scarcer, the need for public information about how water is used, by whom and in what quantities will become increasingly acute - as will the need for information about polluters.
- **Harness the Market.** Approaches which harness rather than supplant market forces respond better to changing circumstances, allow stakeholders to make efficient choices, are subject to public scrutiny and are

less easily captured by vested interests. While well-motivated, administrative approaches tend to be more lethargic, be prone to preferential access, preclude choice in the methods for achieving objectives, and inadvertently encourage wasteful lobbying.

- **Delineate Property Rights.** Clearly defined water rights and markets promote good resource stewardship. It may be useful to break up authority and responsibility and commensurate rights into 3 areas: the rights (1) to extract, (2) to allocate and deliver, and (3) to use. For their part, farmers, resource owners, and service providers tend not to make long term investments that are environmentally progressive if their rights are unclear or insecure.
- **Incentives Must Reflect Resources' True Value.** Experience suggests that policy and incentives play critical roles in the sustainable exploitation of natural resources. A key is to align incentives and scarcity values for goods, services and resources.

Cross-country evidence suggests that subsidizing the use of water to make it more accessible is ill-advised. Undervaluing water leads to it being treated as abundant and tends to exacerbate conditions of water scarcity. Likewise, production support and subsidies mis-align farmers' incentives, encouraging overuse, pollution, and the deterioration of wetlands.

One incentive to promote saving water is a policy that makes wasting water expensive. Removing irrigation subsidies is a first step. Given the possible adverse effects on poor farmers, such a move may need to be done in tandem with the introduction of other measures. Tiered pricing systems can also produce desirable results. They can also be used to protect aquifers and groundwater that are over-pumped.

4. Observations and Opportunities

According to estimates by UNESCO and the International Water Management Institute, Canada is the world's second largest net exporter of water intensive agri-food products, after the U.S. This is not surprising given that Canada is a leading agri-food exporter and has one of the world's highest per capita freshwater endowments. As the world's population and economy continue to grow, demand for freshwater for a myriad of uses is expected to grow commensurately. Canada needs to equip itself to respond to a new era of relative water scarcity.

Australia's experience provides some sense of how relatively bureaucratic regulatory interventions can be partly replaced by positive incentives and market mechanisms (Box 2). Australia is the world's leading exporter of livestock products, which are very water intensive. Although Australia has made significant improvements in water management, recurring droughts and extreme weather may lead to a drop in competitiveness. With favorable endowments of water and land, Canada's agri-food sector could take advantage of this change in competitiveness – provided steps are taken to better manage its own resources.

Box 1: Water Management in “Dry Lands”

Australia's experience with water policy reform is instructive and suggests that good stewardship is more often embraced when infrastructure, institutions, entitlements, obligations and incentives are well-aligned. Pricing and institutional reform combine to ensure the commercial viability of government-linked water infrastructure enterprises. Institutional and entitlement reform combine to better define the business relationship between those allocating water and those using it. Entitlement reform and pricing reform helped better define and co-determine 'product' and 'price'. These refinements allowed the roles of regulators, resource managers, infrastructure operators and service providers to be more clearly delineated, concurrently separating water property rights from land title issues (OECD 2006, a, b).

Most states within the **United States** charge only for a portion of conveyance costs to agricultural water users. Fixed costs and the actual scarcity value of the resource typically are not included. Undervaluation has encouraged the over abstraction of groundwater and aquifer resources and excessive draws on surface water supplies. Over abstraction from the Colorado River and unsustainable pumping from the Ogalla Aquifer are particularly noteworthy (Sumner and Hart). In the short term, such undervaluation amounts to a type of input subsidy and results in the excessive irrigation and increased production of alfalfa, pasture, grain and cotton crops¹. In the longer term, water resources and ecosystems could become stressed beyond repair -- with adverse economic and environmental consequences. This would undermine U.S. competitiveness vis a vis Canada and others. However, it may also contribute to bilateral tensions as the U.S. seeks to divert water from the Great Lakes and other systems. Further deterioration in the water resources in the South-West is likely to heighten such concerns.

China is a net importer of water intensive goods in aggregate, but the water-scarce North is not. This is, in part, due to under charging for water. China's leaders are taking steps to realign incentives, but progress will take time. In the interim, groundwater levels are being drawn down and desertification is occurring at an alarming rate. If left unchecked, both the economy and ecosystems could undergo serious damage. A correction of incentives could result in an expansion of fruit and vegetable production and a reduction in irrigated corn and wheat. Wheat and coarse grains in the North might be scaled back by 15-20 percent if progressive steward practices were embraced. China's demand appetite for livestock products will continue to grow strongly for at least another 15 years, increasing with income growth, and this is likely to broaden the water gap.

¹ In California, water subsidies are thought to constitute almost half of the state's agricultural input subsidies.

Box 2: Mis-aligned Incentives and their Consequences in China

In China's North, over pumping due to under valuation has led to the extensive irrigation of corn, wheat and other cereal crops, resulting in groundwater stresses, desertification, land subsidence, salinization, and other problems. Researchers at China's Ministry of Water Resources, UNESCO, CGIAR and OECD have found that net "virtual flows" (in product form) of water from the arid North to South China are considerably more than the offsetting "real" flows that will occur when the massive South to North Water Transfer Infrastructure Project is finished (Ma et al 2006). Obviously, getting incentives right must be part of any long-term solution.

Input subsidies are among the most production and trade distorting policies, while concurrently being among the least effective from a targeting or transfer efficiency perspective. Research by China's Ministry of Science and Technology suggests that their environmental consequences are even worse (Huang et al 2006). Production and input subsidies and over zealous behaviour by input suppliers, extension agents and officials have led to the extensive pollution of watercourses, with fertilizer and pesticide over-application at 20-50 percent, contributing to excessive nutrient loading.

While the discussion in this box pertains to China, similar remarks could be made for India, Mexico, the United States, and other countries we have surveyed but not discussed in this note.



Water management issues are among the most pressing issues China faces, particularly in the Huang, Huai and Hai Basins.

India's seriously under-values its water resources by providing sizable subsidies to irrigation, pumping activities, fuel and infrastructure. Although water is scarce in India, it is the world's fifth largest net exporter of water intensive agri-food products. Essentially, short term growth is supported by undervaluing and degrading water and other natural resources. Aquifer depletion could soon reduce India's grain harvest by as much as 20 percent. India's demand for livestock products is just taking off but, as with China, it is likely that the water gap will continue to grow as a result.

Mexico's National Water Commission estimates groundwater use at 40% above sustainable rates. Lack of appropriate price signals is a key part of the problem. Depletion of many of Mexico's aquifers has led to rationing and non-price administrative discrimination among user groups, localities, and competing uses. Current policies and incentives leading to over-exploitation in Mexico and the U.S. south-west could lead to increased bilateral tensions over water management issues.

5. Considerations for Canada's Agri-Food Sector

With a relatively small population and 7% of the world's available freshwater resources, Canada is well placed for a world of water scarcity where the real value of water in its many uses becomes more and more apparent.² However, action is necessary to ensure that Canada's agri-food sector and society continue to benefit from the social, economic and environmental goods and services that derive from water resources. Experience suggests that policy and incentives play critical roles in the sustainable exploitation of natural resources. In particular, properly valuing water in all its forms and uses appears to be critical.

International experience and analysis suggest that it is important to go beyond simply pursuing technical measures and covering conveyance costs. Inclusive frameworks that harness rather than supplant market forces are observed to outperform autocratic or purely regulatory approaches in most instances.

² Brazil has 18%, China 9%, India 4% and the US 8%.

Analysis elsewhere also has underlined the benefits of clearly delineating the roles of regulators, resource managers, infrastructure operators and service providers. The separation of water property rights and use rights from land title issues has also been found to improve incentives and resource governance. In general, approaches which build in or internalize rewards for non market benefits and penalties for negative spillovers have achieved success.

To better prepare for the future, Canada's water governance institutions need to explore means of improving our own water allocation and incentive systems. Ongoing collaboration with international expert agencies and countries with experience in dealing with water governance issues should reap significant dividends. Experts in the field have already identified several areas where effort is warranted: plant breeding to deal with water scarcity and changing climate in areas of stress; understanding and better protecting natural capital and ecosystems that will become scarcer in future; inter-agency collaboration to ensure coordinated engagement on water with U.S. and; undertaking more comprehensive bio-economic modeling and "virtual water" analysis to better anticipate water stresses at home and abroad.

International Agencies and Web-Sites

Food and Agricultural Organization
www.fao.org

International Food Policy Research Institute
www.ifpri.org

International Water Management Institute,
www.iwmi.cgiar.org/

Organization for Economic Cooperation and Development, www.oecd.org

United Nations , www.un.org

United Nations Environmental Programme,
www.unep.org

United Nations Educational, Scientific and Cultural Organization, www.unesco.org

World Bank, www.worldbank.org

Readings

Australian Academy of Technological Sciences and Engineering (2006) *Water for a Dry Land*, Canberra.

Dinar, A. & Subramanian, A. 1997. *Water pricing experiences: an international perspective*. Tech Paper 386. World Bank.

Environment Canada, accessed 15 Feb 2007, http://www.ec.gc.ca/water/en/info/facts/e_quantity.htm

FAO (2002) *Crops and Drops*, FAO, Rome.

Han Jun (2006) *Effects of Integrated Ecosystem Management on Land Degradation Control and Poverty Reduction*, in OECD: *Environment, Water Resources & Agricultural Policies*. Paris.

Huang, J K, Hu R F, Cao J M, and S. Rozelle (2006), *Non-Point Source Agricultural Pollution*, in OECD: *Environment, Water Resources and Agricultural Policies*.

Land and Water Australia (2002) "Property: Rights and Responsibilities – Current Australian Thinking", 155 p.

Ma, J, Hoekstra, A, Wang, H, Chapagain, A and D Wang (2005) *Virtual versus Real Water Transfers within China*, *Phil., Trans. Royal Society* 361, pp. 835-842

OECD (2002a) *Agricultural Policies in OECD Countries: A Positive Reform Agenda*, Paris.

OECD (2002b) *The Incidence and Income Transfer Efficiency of Farm Support Measures*, OECD, Paris.

OECD (2006a): *Water and Agriculture: Sustainability, Markets and Policies*, Paris

OECD (2006b): *Environment, Water Resources and Agricultural Policies: Lessons from China and OECD Countries*, Paris

Rosegrant M. X. Cai, and S. Cline. 2002. *World Water and Food to 2025: Dealing with Scarcity*. Washington: International Food Policy Research Institute and International Water Management Institute.

Seckler, D, D Moldon, R Barker, (1998) "Water Scarcity in the 21st Century", *Water Brief No.1*, IWMI

Shiklomanov, I (1999), *World Water Resources at the Beginning of the 21st Century*, State Hydrological Institute, St. Petersburg.

Sumner, D, and D Hart,(1998) *Government Policy and Agriculture*, in *California Agriculture: Issues & Challenges*.

World Bank (2005). *India's Water Economy: Bracing for a Turbulent Future Agriculture and Rural Development Unit*, DC.

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May 2007

Project No. 07-044-b